Texas Highways

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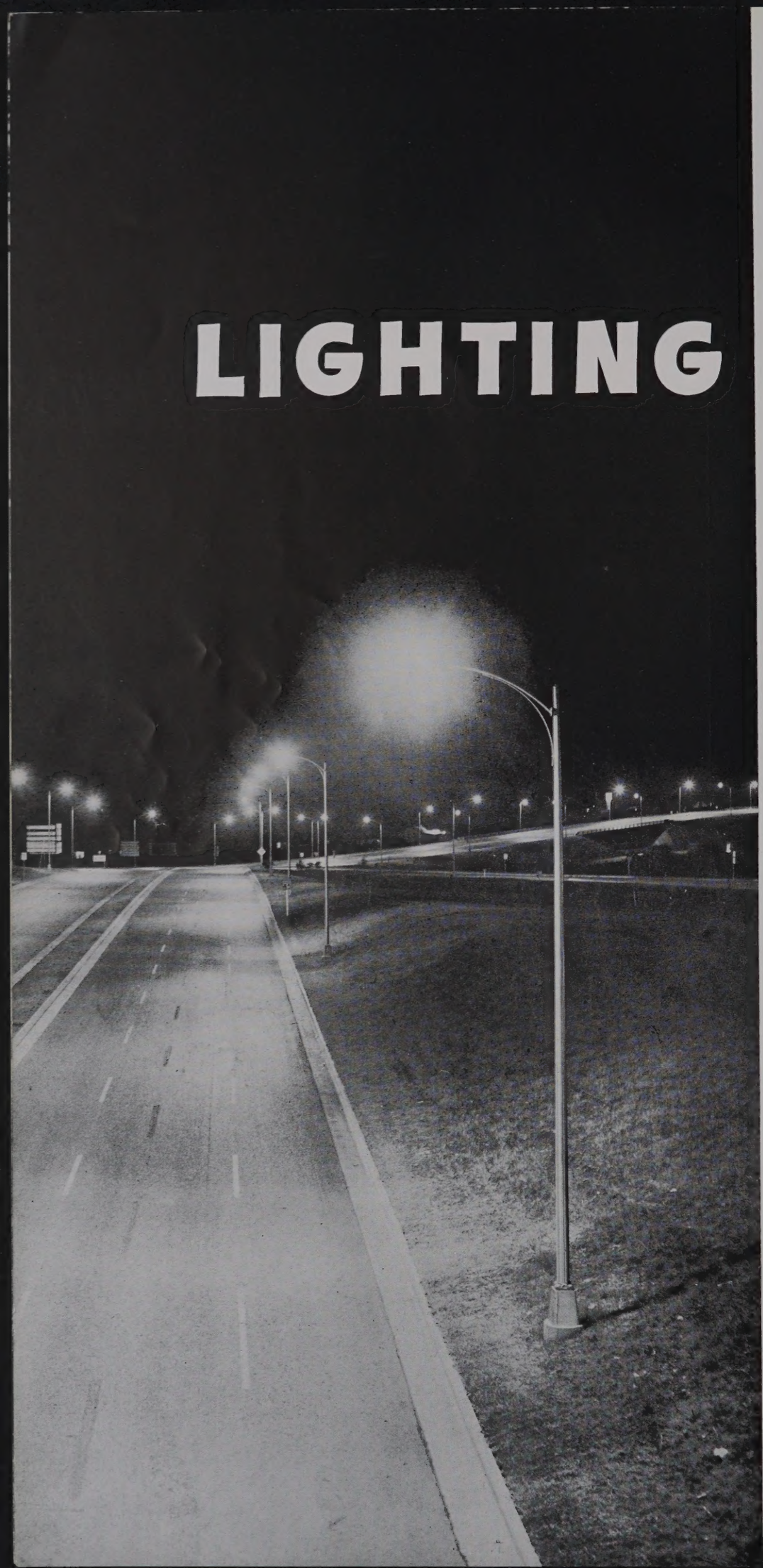
LIGHTING OUR



What is enough light? Where? How? An illuminating engineer is making the calculations about a whopping slice of Texas out-of-doors classified as an express highway.

Increasingly the cities of the state with urban mileage of this sort are lining up at the engineering drawing boards of the Department to receive clinical answers to such questions. More and more the properly turned-out urban expressway expects treatment for nighttime illumination.

Talk with Hubert Henry who, assisted by Stuart Williams and Ben Gray, handles the Illumination Section, Highway Design Division, for T. S. Huff, Chief Engineer. This group of engineers will point out that expressway lighting in Texas is a comparative fledgling, born since the Department wedded the superhighway.

On U. S. 81, west of Temple three years ago this garland of 262 luminaires first began their duty. Bell County and six other counties received expressway lighting that year, making 1956 a record year since the first expressway was given such treatment in El Paso in 1948. Average cost of each unit shown here was $514.21.

EXPRESSWAYS

Nella Dieter, Journalist
Information Statistics

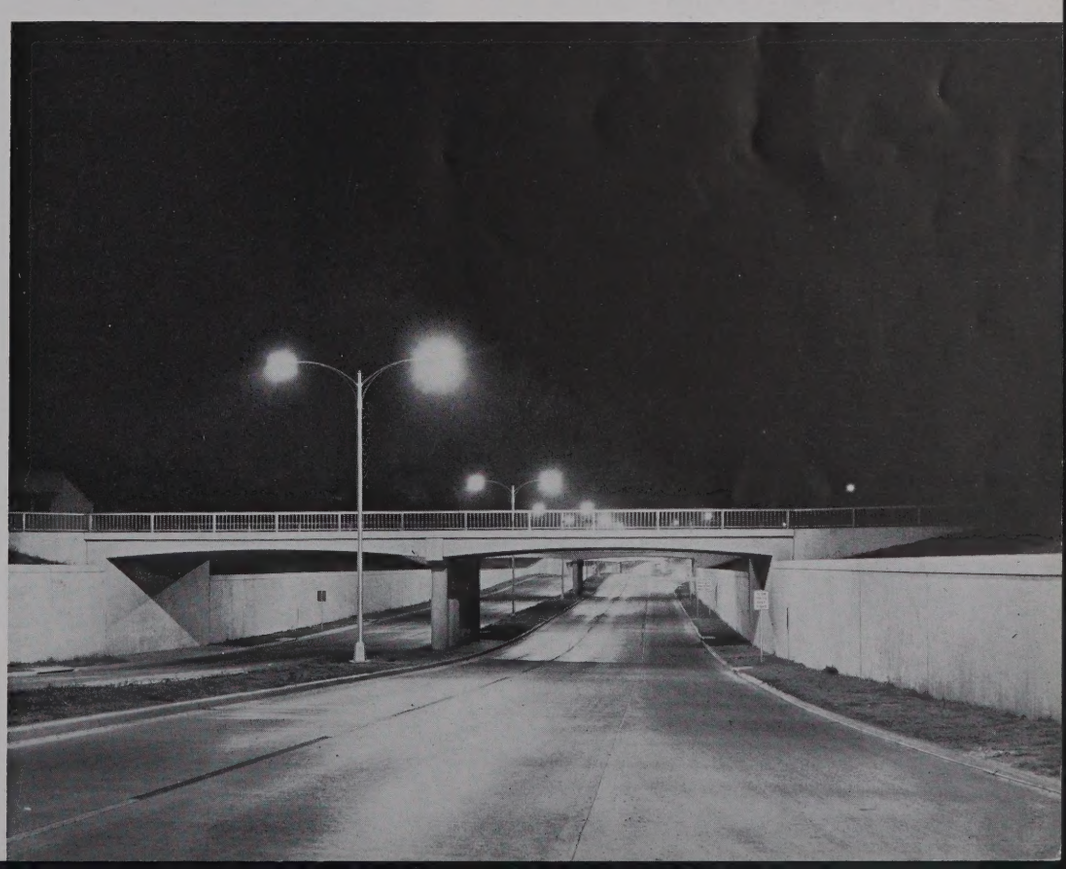
They will remark in retrospect that in other states, too, the drafting tables creating superhighways have delivered the bumper crop of urban expressway-lighting systems which are fast becoming a rule.

The "illumineer" (descriptive nomen for highway lighting specialists, coined by the hucksters of highway lighting items) until only recently prescribed expressway lighting schemes which came in great measure from his trial and error experience and that shared with him by others in his profession throughout the nation. Now, however, trial and error are being replaced by findings proved by research.

What is enough light on an expressway? Stuart Williams, Designing Engineer, says the correct amount is calculated by considering what it is necessary for the motorist to see, and the position on the roadway from which he is supposed to be able to see it. He enumerated the basic illumination places: points of decision, points of merging, and points of intersection. "Frequently, light is needed also between such points to add to driver comfort," he added.

The Department, recognizing that highway lighting is far from being an advanced engineering exactitude, is active in research on the subject. Studies made on rural highway intersections and on interchanges outfitted with experimental illumination schemes were the subject of a recent policy-deciding meeting of several district engineers with Chief Engineer Huff. The District chiefs traveled in a group to make on-the-ground studies of project sites in East Texas and the Rio Grande Valley.

Too, that research helpmate of the Department—the Texas Transportation Institute at Texas A. & M. College—has worked nearly two years on a project to determine the effect



The latest tally shows that the San Antonio District has more expressway lights in operation than any other at the present date—985. Tarrant County falls second in line, then Dallas. The lights shown here on the U. S. 81 expressway in San Antonio are mounted on "twin-arm" brackets.

Until the Corpus Christi High Bridge illumination job, this nighttime scene along Broadway Boulevard in Galveston represented the largest concentration of poles, brackets, and luminaires in Texas. There are 456 units lining 4.2 miles of expressway here. This was the first job in which the Department used a constant wattage ballast (transformer) for each pole.

of various types of intersection lighting on traffic performance and safety.

The illuminating engineer's answer book, which contains the distillation of knowledge based on nationwide findings up to now, is the Illuminating Engineering Society's "Standard Practice Manual." A committee on Street and Highway Lighting has been part of the IES for 33 years, and as far back as 1928 it began publication of recommendations "appropriate to modern requirements." Eight times during that period has the Manual been brought abreast of the latest experience and modern equipment.

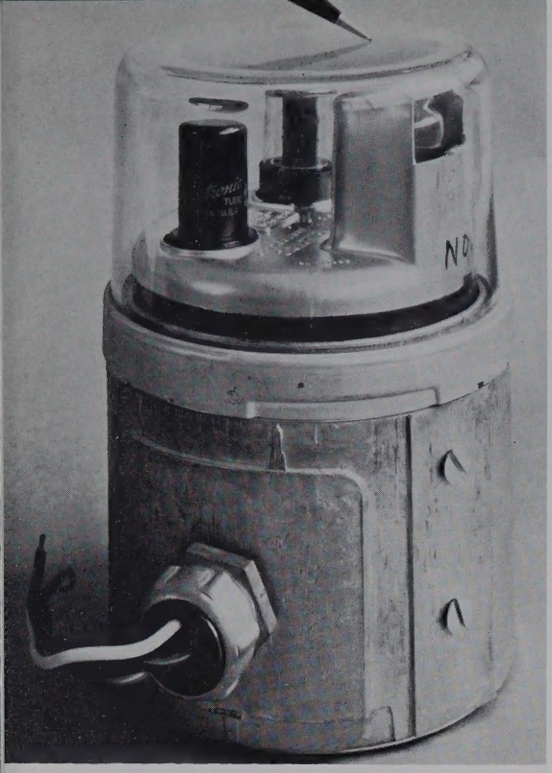
What the Manual sets down as "Type III, lateral distribution," is the pattern most generally specified by the engineer for Texas highways. Type III light distribution has a preferred lateral width of 40 degrees, with an acceptable range of 30 degrees to less than 50 degrees and is intended for luminaire mounting at or near the side of the roadway. This pattern not only proves economical because it permits placing luminaires farther apart, but it is a type which more nearly provides light in the area between curbs of wide roadways.

The globe, reflector, refractor, and all parts of a highway lighting fixture except the pole and bracket are known to the engineer as the luminaire. More than 4,000 of these illuminate critical sections of the expressways in eleven cities of the state. Their number will increase. Cities twelve, thirteen, and fourteen were designated recently.

Lumens per square foot, or foot-candle values, are of first concern to the men whose job it is to decide the what, where, and how of lighting. According to Williams, the Texas Highway Department chooses the illumination intensity recommended by IES for various traffic conditions. This, say the foot-candle charts in the Manual, should be eight-tenths lumens per square foot, where vehicular traffic is heavy and there are no pedestrians. To accomplish this the most generally prescribed lamp is a mercury-vapor type, 400 watt, 21,000 lumens. This lamp, mounted at least 30 feet above the roadway to reduce glare will burn about 6,000 hours—roughly, a year and a half.

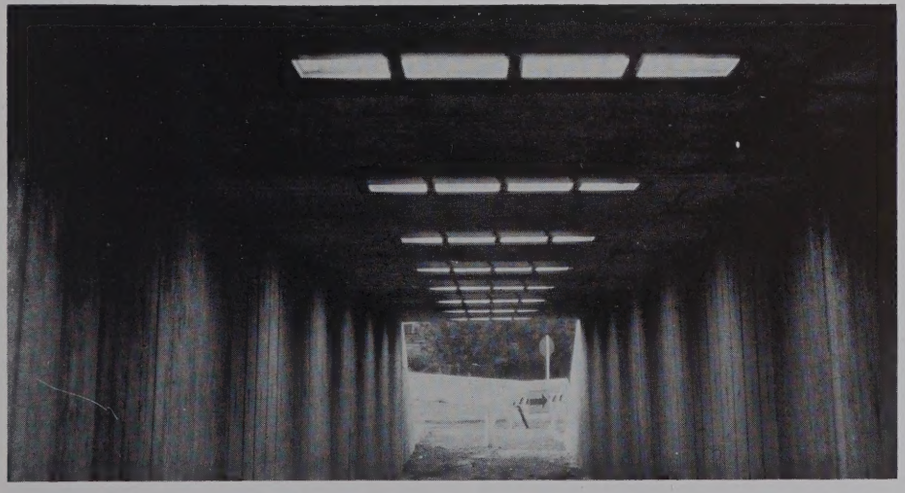
Frontage roads generally are not lighted except where they become part of the interchange. On those of the state's urban expressways which are lighted, continuous lighting on the through lanes and continuous lighting throughout the interchanges prevails. Structures usually are treated the same as roadways, and when it becomes necessary for low mounting

The aluminum pole shown at center-left is the tallest expressway illumination pole in the state. It measures 69 feet in height and towers over the highest level in the four-level (Pretzel) interchange at Fort Worth. Notice the black splice about halfway up the pole. From this point to the tip is 30 feet.



The pencil points to a light-sensitive photoelectric cell which is part of the transformer station —the source of power for an expressway-lighting system. Through amplifying tubes at left it operates a relay located in the base of the container. As long as light strikes the photoelectric cell at an intensity of more than ten foot-candles, current flows through the relay. When darkness falls, the current no longer flows, and the relay closes. This sends an impulse to the oil switch, and the expressway lights turn on.

The plan sheet for a new system of lights along some urban expressway in the state is discussed in the Austin office by Hubert Henry (left), Supervising Designing Engineer, and Stuart Williams, Designing Engineer. Illumination Section of Highway Design Division acts as design consultant to the Districts.

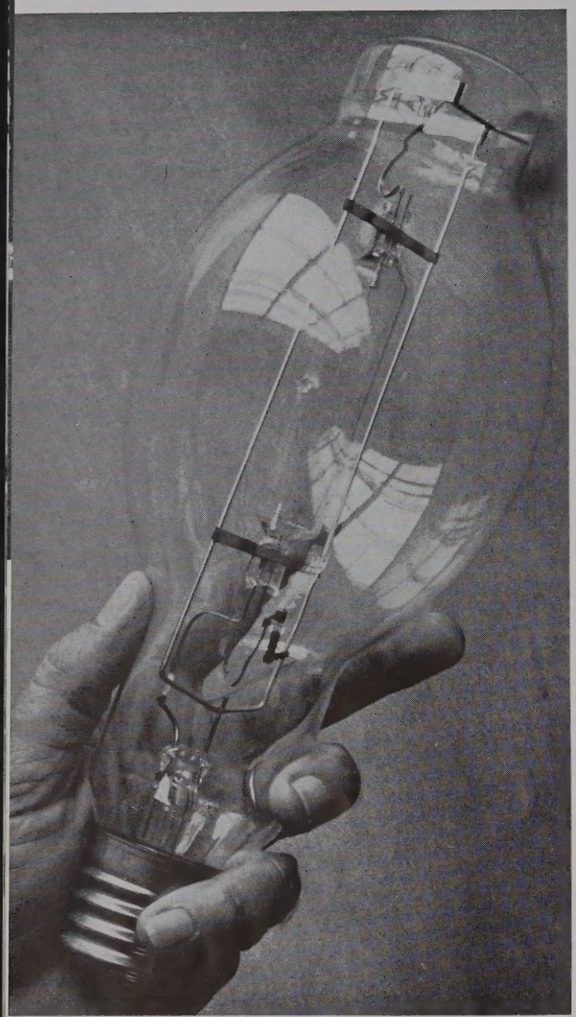


In Fort Worth, just north of the four-level interchange, in an unfinished roadway project, this pedestrian underpass—only one of its kind in the highway system—has been equipped with vandal-proof overhead lighting. A series of two-tube fluorescent tubes has been recessed in this ceiling which is less than eight feet high. Tempered glass protects the tubes, and the recessed design of the fixtures will discourage vandalism or pedestrian tampering. This unit was designed by Stuart Williams.

heights—say, on a pedestrian underpass or a roadway underpass—Department policy is to switch to a fluorescent-type unit, thus reducing glare. Such units are installed overhead.

El Paso was the first city in which the Highway Department installed a complete roadway-lighting system. By present standards, the number of luminaire units located along Paisano Drive in 1948 was small. On the heels of the El Paso job—seven months later—the lights of the Texas Gulf Freeway in Houston were turned on. The Mayor and other Houston city officials as well as Highway Department officials made a ceremony of the moment switches were thrown.

Every new lighting standard installed since the Lubbock job in December, 1955, has been specified aluminum. In all of these projects, too,



A mercury-vapor lamp such as this, plus a reflector and a refractor, make up a "luminaire" from which light is sent down to the expressway. This 400-watt, 21,000-lumen lamp will burn about 6,000 hours. The Department estimates that in those cities where it is responsible for maintenance and operation of an expressway lighting system, the average cost is $40 per luminaire unit per year.

the 400-watt mercury-vapor lamps are used.

During the eleven years since the contracting of the first lighting jobs in El Paso and Houston, the Texas Highway Department has overhauled its financing policy several times. At El Paso and the other early lighting projects installations were 100 per cent state financed. This means the Department paid the tab not only for constructing the system but pays also for maintaining it. Later the policy between the Department and the cities became 50-50 sharing of installation costs and 50-50 sharing of maintenance and operation. The most recent plan of Departmental financing was stated last December by the Highway Commission to supplement the 50-50 policy: The State may foot the installation bill 100 per cent, if the City accepts the entire responsibility for maintenance and operation.

Cities themselves take the initial step in the required sequence of events before an expressway finally wears its brace of luminaires. First overtures are made on a district level, after which the district engineer will make recommendation to the Highway Department administration through the Chief Engineer of Highway Design in Austin. If the main office engineers are in favor of the project, the proposed work is then described in a minute order written at the direction of the State Highway Engineer. This the Highway Commission considers when the matter comes up at the monthly Commission meeting. If passed, the project then goes on the drafting boards in the district. Any technical snags encountered in its design are referred to the staff of the Illumination Section, Highway Design Division, in Austin. After the plans are completed, competitive bids are sought. When the job has been awarded, construction begins. In his contract, the successful bidder has agreed to set the trans-

This entire luminaire weighs only twenty pounds. Ben Gray, Engineering Assistant, fits a 400-watt mercury-vapor lamp into a socket mounted in the highly polished metal reflector (left). The arrangement of lines on the glass reflector (at extreme right) provides a system of prisms which distribute a given pattern of light on the pavement.

Gray (left) and Williams point out one transformer station of the three on U. S. 81 north of Austin which empower approximately 174 luminaire units of the single-arm type shown. Above the distribution transformer, appended cricket-like to the pole, is the photoelectric cell with a patch of white visible. Above that is a primary switch. An on-off manual switch on the lower half of the pole is used during times the luminaires require servicing.

former station, trench the cable, set foundations, and install poles and luminaires. The contractor supplies the equipment and fixtures in accordance with plans and specifications. The resident engineer represents the Department during erection of the project, calling on the Austin Office staff for assistance if on-the-job problems arise for which they are needed.

A power source is required, of course. And with each job, if the utility does not supply a transformer pole, the Department sets one. From that point electricity is routed to each light standard and luminaire. Photoelectric cells automatically turn on the lamps at a given point with the waning of natural light.

Generally, a multiple circuit is used in these mercury-vapor lighting projects, with a constant wattage ballast (transformer) fitted in the base of each pole. This is in keeping with the illuminating engineer's research for constant lamp wattage and a uniform light output from all the luminaires of a section of expressway.

This circuit arrangement was first used in Texas in 1953 for the illumination of 4.2 miles in Galveston after the Department had sent personnel to study methods and equipment being used in the Chicago Park District, which had used constant wattage ballast more extensively over a longer period of time than any other organization in the country. "The constant wattage ballast offers the usual installation and maintenance savings of the multiple system, without the cost of providing additional power sources and transformer stations which the conventional low-voltage circuit requires," Hubert Henry explained.

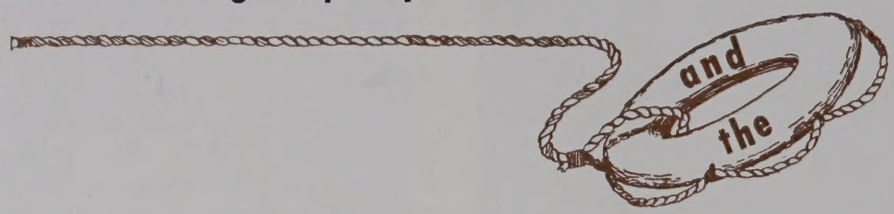
With constant wattage ballasts in the circuit, all the lamps will give constant light output even if there is variation in the input voltage. From 200 to 260 volts—a 60-volt variation—the present constant wattage ballast systems will adjust and give uniformity in lighting. However, each system is designed for a specific project, and all factors must be considered individually and the design varied accordingly.

Lighting the Corpus Christi High Bridge, for example, required variation from the general multiple circuit 240-volt, single-phase plan. Power for the bridge was doubled to 480 volts because of the extreme distance between some of the luminaires and the source of power (transformer poles). The same solution was given to the illumination problem at the intersection of Interstate Highway 10 and the Buffalo Bayou Bridge near Houston, with the exception that a 480-volt multiple *three*-phase circuit was used.

Right now four illumination jobs are under contract and under construction in Port Arthur, San Antonio, Amarillo, and on the Corpus Christi high bridge and its approaches. These will add 611 luminaires to the expressways. Three more jobs will be placed under contract very soon in Austin, Fort Worth, and Amarillo. These will add another 259 units. Altogether, 900 more luminaires will have been placed on Texas urban expressways before the year is over.

For each of these locations the design finally accepted will accomplish those urban expressway lighting needs considered the most economical. And Department illumineers will continue to determine design not only by the special considerations involved but also by advances in the science of highway illumination.

the texas highway department



WATER SAFETY ACT

The Highway Department, ordinarily concerned with building roads and bridges for the ever-increasing number of motorists, now finds itself concerned with the ever-increasing number of boat owners.

House Bill 11, the Water Safety Act passed by the Fifty-sixth Legislature "promoting safety by regulating vessels, water skiing and aquaplaning upon the waters of this state. . . " sets up requirements and restrictions affecting every boat owner in Texas. Owners who power their boats with a motor in excess of ten horsepower are required to obtain a license.

Motor Vehicle Division has been assigned the responsibility of issuing numbers to all boats falling in this

category. (There are an estimated 150,000 boats throughout Texas which will fall under the Act.) In addition to requiring identification numbers, the law specifically states complete equipment regulations—listing certain safety equipment which must be maintained at all times when the boat is either underway or anchored away from dock. Copies of these regulations will be available through law enforcement agencies and Motor Vehicle Division. A copy will also be sent to boat owners along with their Certificate of Number.

The new numbering system becomes effective April 1, 1960. On or before March 1 of 1960, every Texas boat owner affected must have filed application for a license number. Applications will be available through boat dealers, sportings goods stores, city and county offices and law enforcement agencies.

This application, along with proof of ownership—such as a bill of sale, invoice, or affidavit of ownership if the boat is homemade—and the correct fee, must be submitted to Motor Vehicle Division of the Highway Department. Fees should be submitted either as cashier's check or money order. Stamps, cash, or personal checks should not be sent.

As with automobiles, registration fees for the new law will be governed by the size of the vehicle. In line with federal boating regulations, four classifications of size have been made and fees assigned to each. Fees listed below are for a three-year period, extending from April 1, 1960, through March 31, 1963.

Class A (less than 16 feet in length)	$ 1.00
Class 1 (16 feet and over but less than 26)	5.00
Class 2 (26 feet and over but less than 40)	10.00
Class 3 (40 feet and over)	12.50

At any time during the three-year period, registration fees, upon application for a license number, will be prorated quarterly with a minimum fee of one dollar.

If a boat owner changes his address, transfers the boat to another owner, or destroys or abandons the boat, Motor Vehicle Division should be notified and the Certificate of Number surrendered.

When a boat is sold by a dealer, the new owner will be issued a temporary number by the dealer which

will identify the craft until the owner receives his Certificate of Number from Austin. The number on this Certificate becomes the identification number of the boat. The Certificate of Number must be on the boat whenever it is in operation, rather than on the person of the owner. Without a Certificate of Number, the boat cannot be legally operated in this state.

Size of the boat determines the size of the numbers which must be painted, or attached with individual numbers and letters to the bow on both sides of the boat. On all boats under 26 feet in length, each digit and letter must be a minimum of three inches high. If the boat is 26 feet long or

Formulating plans for administering Texas' new boating laws are Motor Vehicle Division personnel J. B. Smith, Chief Supervisor, Correspondence Section; Dan Mills, Chief Supervisor, Accounting Section; Bob Brewer, Chief Supervisor, File Section; D. T. Harkrider, Director, Motor Vehicle Division; Bob Townsley, Chief, Registration; Bill Litton, Supervisor, Dexigraph-Microfilm Section; and Bart Couch, Chief, Certificate of Title.

over, numbers and letters must be a minimum of four inches high. Owners will be required to attach the state-assigned numbers since there will be no actual license plate issued. The number and background must contrast for legibility. Each identification number will contain a maximum of four digits, prefixed by a "TX" and suffixed by a combination of two letters of the alphabet.

Although only boats powered by motors of above ten horsepower are required by law to obtain licenses, D. T. Harkrider, Director of Motor Vehicle Division, points out that no matter what power rating a boat may carry, it is advantageous to the owner

to register his boat. "The boat's registration will provide an inexpensive way of quick and positive identification should the craft be stolen or otherwise involved in difficult circumstances," he added.

The Water Safety Act also requires the filing of accident reports. These reports will assist in charting the changing relationship of water sports to water safety, indicating areas where additional protection or legal changes will be needed.

Within 30 days after an accident, the occurrence must be reported to the Motor Vehicle Division if (1) property damage was in excess of $100; or (2) there was a resulting injury or death. These reports are confidential and not admissible in court as evidence.

Under the new Act, any person who operates a vessel or manipulates water skiis, aquaplane, or the like, while intoxicated, under the influence of intoxicating liquor or narcotic drug shall be subject to prosecution. Conviction carries a sentence of fine or imprisonment.

There will be no central enforcement agency for the water safety laws. However, all peace officers of the state and political subdivisions are vested with the power and authority to enforce provisions of the Water Safety Act.

The new law supersedes all municipal or county regulations concerning registration of boating. Local governments may continue or enact new regulations of operation as long as they are not in conflict with the Water Safety Act. Penalties for violation of the new statutes range from a fine of $10 to a fine of $500, six months in prison, or both—depending on the severity of the misdemeanor.

This Texas Water Safety Act is in compliance with the uniform Federal Boating Act of 1958. This law applies to all states having inland waterways or lakes. In those states which do not pass such law by April 1, 1960, the

United States Coast Guard is empowered to administer the Act until the states adopt the legislation themselves.

On the reasons for initial enactment of the legislation, Harkrider said, "This is a clear-cut case of the misdeeds of a few cutting down on the freedom of all. The Act is designed to make boating safer. We hope through the new law this will be accomplished."

Preventive Maintenance

Back in the early days the equipment supervisor knew every nut and bolt, every tire and other accessory on all equipment. Twenty years later —with five times as many miles of highway to maintain and four times as much equipment—he probably doesn't see the equipment until it comes in for shop repairs. This means that there are some parts of the job that do not get proper attention.

To overcome this situation, two districts have added extra help. Both now have a second equipment supervisor, whose daily work is inspecting equipment.

About Douglas Cardwell, who holds this position in District 2, Administrative Engineer Joseph M. Bingham writes: "The first few weeks alone the savings on recovery of truck and grader tire cord bodies for recapping more than justified our decision to add this position."

About George W. Seelke, who has held the new position in Houston District for a year, W. W. (Bill) Hunter, Senior Equipment Supervisor, says: "In one short year we can see the results [of specialized attention] . . . We tripled the amount of tire recapping last year, which cut new tire costs. By catching needed minor repairs before breakdowns occurred, we have saved down-time loss, expensive major repairs, and replacement losses."

Both Cardwell and Seelke were veteran employees. Seelke for twelve years had been both district mechanic and assistant shop foreman. In District 2 Doug Cardwell had been in the district warehouse for more than 26 years. For a number of years he had been in charge of the tire and recapping needs of the district. Also, he knew equipment and parts.

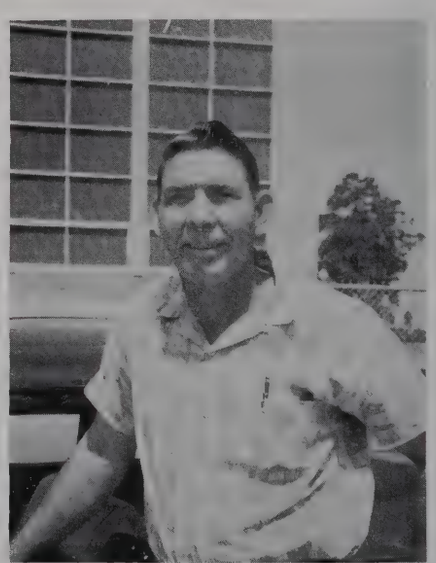
Douglas Cardwell, Equipment Supervisor, District 2.

How District 2 Inspects

With the increasing miles of highway to maintain, the major equipment in District 2 also multiplied. The Senior Equipment Supervisor was completely occupied keeping new equipment coming in and maintaining a smooth-running district shop which would turn out the repairs required by the rolling stock on the enlarged inventory.

Cardwell's specific assignment was to inspect equipment and tires, under the supervision of the Senior Equipment Supervisor, J. N. Maloney. Again quoting Administrative Engineer Bingham of the district: "Many of our foremen and operators had begun to feel that battery water, oil changes, lubrication, and minor repairs were all being taken care of as a matter of course. Doug Cardwell found quite the contrary to be the case. Lots of equipment was being partially lubricated at proper intervals, but in many cases vital points were overlooked."

Further Fort Worth District preventive-maintenance measures, according to the Administrative Engineer: "On the theory that a mechanic must have tools to do any kind of job properly, we are in the process now of furnishing all section ware-



George W. Seelke, Equipment Supervisor, District 12.

houses with needed additional hand tools and tire-service equipment. Likewise, we have improved lubrication information and facilities."

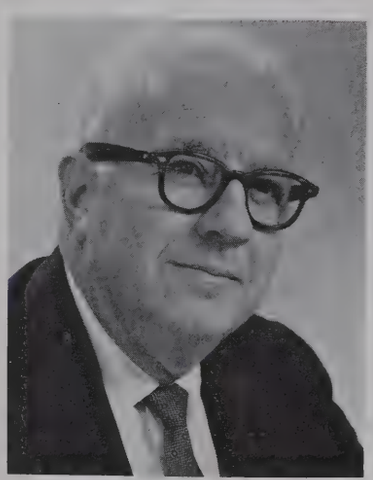
Supervisor's Work Described

George Seelke, Equipment Supervisor in the Houston District—which must spend millions of maintenance dollars for new expressways, underpasses, barge and ferry operations and is becoming responsible for an increasing amount of new equipment each year—works daily with maintenance foremen and operators throughout the District. Bill Hunter, Senior Equipment Supervisor, describes Seelke's activities: "With District personnel he inspects the operating condition of all equipment. He discusses at safety meetings the recommended lubrication and maintenance methods. When a new piece of equipment is delivered, Seelke takes a factory representative, if possible, with him when he turns the equipment over to the maintenance foreman. Operators are brought in, and all available information on operation, lubrication, maintenance, and tire care, is discussed.

Inspection Elsewhere

Some districts have assigned the job of inspecting tires and equipment to district mechanics. Some have installed in each county warehouse section mechanics who are responsible for this checkup. Still others, where the miles of maintenance are low, assign one mechanic for two or three adjoining counties when distance from the District Shops is 50 to 100 miles. And in some districts the senior equipment supervisor is still able to keep close touch with all equipment and tires.

Report to the Districts



John B. Nations, Director Equipment and Procurement Division

About eighteen months ago D-4 stepped up its preventive-maintenance program on tires, particularly emphasizing recapping. This was a necessary undertaking, begun after several years careful study of the subject. New tire purchases in some districts were mounting in number out of line with state-wide averages. To expedite the recapping program, services of a tire specialist were added to the Division, and careful consideration of safety was given in all our recommendations.

Response has been tremendous. Cooperation has been wholehearted and helpful. Our original ideas proved to be just a basis or foundation from which a pyramid of additions has been built by maintenance men in the field. Scores of new ideas have come in. Suggestions from equipment supervisors in the 25 districts have spelled new economies, and the program has now expanded to include major equipment as well as tires.

At least three district engineers have said that tire-program savings were the springboard to their interest in economies with equipment, materials, and maintenance methods. One district chief remarked of our preventive-maintenance program, "All we needed was a boost in the right direction, and immediately we began to get results." Another district engineer wrote us, "Keep the information coming. You've just scratched the surface."

Here are excerpts from the mail arriving from all directions: "Your P-M Manual is very good. Send twelve more copies." "Our foremen use the P-M Manual at warehouse sessions and safety meetings attended by operators and mechanics." "When can we show your P-M color film in our district?" This from an East Texas equipment supervisor: "Your P-M program is going over because you haven't resorted to 'finger pointing' and unjust criticism. You've come into the districts and tried to help us, not hinder operations."

Our preventive-maintenance program was undertaken with limited funds. Only one man could be assigned to concentrate on the job. However, in the final analysis, the program is working because of what the engineers, equipment supervisors, maintenance and warehouse superintendents, and maintenance foremen have done and are doing. Not one man in the entire 25 Department districts was unwilling to cooperate when he understood the reasoning behind our moves and the necessity for improving all phases of our preventive-maintenance practice.

D-4 sends its thanks to all in the field who are wo king in the interest of preventive maintenance.

PORT ARANSAS CAUSEWAY

A new state-owned causeway will carry traffic from Aransas Pass to Port Aransas by next summer. This causeway, designated State Highway 361, will completely replace the ancient plank causeway which was put into service in 1931.

The present one-way causeway with turnouts for meeting oncoming traffic has withstood the furies of several hurricanes which put it out of commission for as long as three months. At such times, the only way to reach Port Aransas was by ferry.

The new causeway follows the same general pattern as the one now in use—terminating at Harbor Island, from which County-owned ferries transport vehicles to Port Aransas. The ferry operates over the Corpus Christi Ship Channel. The present causeway carries approximately 500 vehicles per day; estimated traffic count anticipated over the new causeway is 2,000 by 1975.

Three Highway Department-built bridges dot the 6.42-mile causeway. One higher-level bridge—over a rerouted Intracoastal Waterway—was built by the Corps of Engineers. The new causeway bridges are at elevation 12, which should clear any hurricane. They have been designed so that high water will go over the fill and under the bridges.

Present fee for the County-operated causeway and ferry is $1 a trip. When the new causeway goes into operation the only charge will be 25 cents for the ferry, which will continue to be operated by the County.

The new Port Aransas Causeway is being constructed along a route about 240 feet southeast of the present causeway. Hydraulic-fill placement began in May 1958 when two dredges moved into position to begin pumping fill from the bay floor. Working around the clock, stopping only for bad weather and occasional mechanical breakdown, the dredges brought up more than two million cubic yards of material during the nine-month period they were in use. Of the total material dredged up, only 40 per cent—about 800,000 cubic yards—was actually placed. Some 35,000 cubic yards were stockpiled and the rest became runoff waste.

The three Highway Department bridges are of concrete slab and girder construction varying in length from 153 to 2,002 feet. The massive Gulf Intracoastal Waterway Bridge built by the Corps of Engineers is 2,096 feet long and allows free passage of commercial and private waterway traffic beneath.

On Department-built bridges there is planned a total of 9,400 cubic yards of concrete riprap along the approach fills for erosion protection during heavy wave action caused by high winds and storms.

Pavement width on the roadway is 24 feet, with eight-foot shoulders. Normal grade on the embankment portion of the causeway is 6.5 feet. The causeway is designed for a speed of 60 miles per hour.

Total cost for the entire project is estimated at $2,289,000—$664,000 of which is the cost for the Intracoastal Waterway Bridge.

This hurricane-scarred old causeway allows only one-way traffic with occasional turnouts for two-way passage.

Alongside the present causeway, 240 feet to the southeast, the new causeway is built to withstand the most severe weather.

At the causeway termination point —Harbor Island—vehicles board ferries which take them across the Corpus Christi Ship Channel, landing them at Port Aransas on Mustang Island.

The Gulf Intracoastal Waterway Bridge, necessitated by the re-routing of the Waterway, rises 50 feet above the water.

Twenty-four-foot roadways will replace the pock-marked roads of the present causeway, with eight-foot shoulders.

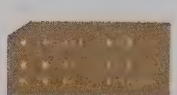
As the dredges work, silt and muck flow to the outer slopes, while the heavier particles of sand and shell are deposited in fill for the roadway.

Bridges for the causeway, totaling .88 of a mile, are completed. Finishing-up procedure is underway here.

Gracefully arching above the Intracoastal Waterway is the bridge built by the Corps of Engineers, 2,096 feet long.

On top of the hard-compacted subbase of fine sand and oyster shell particles, base and paving must be placed along the 5.54 miles of causeway.

Making Better Use of Manpower Through Mechanization and Automation



A valuable bridge-design program—our first computer structural design program—has been recently secured from the Georgia Highway Department. Georgia spent two years developing this program. Its great value is that the work it does will replace that of more highly trained personnel than any of the previous computer programs.

This program will perform most of the design computations necessary in designing continuous units such a I-beams, plate girders, concrete slab or girder, box girder, and the like. It computes all of the moments, shears, reactions, and deflections normally needed for these units, considering dead loads and live loads of H and H-S types placed in positions to cause maximum effects.

These computations, when done manually, will oftentimes require the engineer to spend several days of detailed computation work. Filling out of the input form for the IBM machine will require at most 45 minutes. The computation time required to run this program is about twelve minutes.

Travis A. Long, Supervising Resident Engineer
District 14

For the past several years we have been quite concerned about having enough personnel to take care of the accelerated program in our highway planning and construction. For this reason it has become necessary for all supervisory personnel to try to think of ways to make better use of the personnel that we have and to make our organizations work in a more efficient manner.

We realized too that there was just so much any individual could do, and after we had loaded our personnel to the limit then there were two choices we had left to make. One was to get additional personnel and the other was to farm out part of the added work to someone else. In many cases it was almost impossible to get added personnel that could take care of the work without months of training and close supervision.

As always in this land of ours, someone came up with a machine to relieve more people for other work, and in this instance it was the electronic computer that was introduced into the Highway Department. Possibly your first impression of the machine was the same as mine. I thought it was a mighty high-priced calculator and that someone had really been a good salesman to convince Department officials they needed this gadget. I will have to say that my impression is completely different today, because our computer section has proved to me that they can really do the work in minutes that use to take men days to do. We have served somewhat as guinea pigs for this work because of our location, and we have truly benefited from it. Time will not permit

*Speech presented at the Thirty-third Annual Short Course.

us to get into any detail about the work we have had done on the computer; but there are several good uses we have made and are making of it, and I would like to tell you what they are.

The first use we made of the machine was the calculation of traverses, which is necessary in the preparation of deeds for right-of-way purchase. This machine calculates and prints for you in minutes what takes hours for a man to calculate. By furnishing on a form the information necessary to make a traverse calculation, it will return to you the unknown sides or angles and the area within the traverse, as well as giving you the error of closure. If you provide the wrong information, then the error will show up on the returned information sheet, and it's up to you to find the error *you* made. The information can be obtained from any shape section, curved or otherwise, as long as you give the needed information.

There is also an inter-determinate traverse program that is very useful in the calculation of distances and angles or bearings in an intersection composed of several curves. Simply by setting certain points for P.I. and angles, a series of traverses can be worked out in an area where each traverse is dependent on information calculated from another traverse. The computer is capable of remembering dimensions and bearings from one traverse to the other; in fact, its memory is much better than that of the human being.

Another use we make of the computer is in the hydraulic calculations for determining waterway area in design of bridges.

We are also making use of the computer in setting up a coordinate system for doing all construction staking by means of triangulation. We are proposing to use this network for staking the project in downtown Austin where the terrain and traffic would make chaining a most difficult task. In a matter of minutes the computer can calculate bearings and coordinates to any point on the ground, such that by using two theodolites from two previously set points we can establish the location of any other point by turning one angle. This, we think, will be of tremendous advantage in controlling this project. We will need some means of communications between the three points.

The program that we are now using is to me the biggest time saver we have encountered. This program is the taking of the cross-section notes and compiling on a sheet the elevations and distances for the entire project. The cross sections are taken by marking the rod readings and distances on a mark-sensing card instead of putting this in a field book. By feeding these cards into the computer, it prints up on a form the exact information you have on the cards or it will calculate elevations from the rod readings and print for you the elevations instead of rod readings at all the distances.

If you desire profiles at certain distances, it will interpolate and print the elevations for points at any distance you want to choose. You can give the machine elevations for your finished roadway section and decide on an outside slope, and it will calculate all the cut-and-fill volumes, figure your fill, plus shrinkage—you determine the shrinkage factor—and give you an accumulated total for use in plotting a mass diagram. We are now in the process of completing a set of plans without plotting one cross section on paper. This project is nine and one-half miles long, is in a rural area, and has continuous frontage roads. One man is doing all the alignment, profile, and grade work on this set of plans. When the first try on grades does not balance, it is quite a simple and quick task for him to change the grade and give it back to the machine and get results in a very short period of time. I think this program alone would be worth what we have to pay for the machine, if all districts would take advantage of it.

This in general is about the extent of the routine field work involved, except the bridge program that you have heard about previously. In closing, I would like to say that I am most grateful to the computer section for their interest and their help. The entire section have gone into the field with my personnel to try to better acquaint themselves with the problems and the terminology. I think this group deserve praise and commendation for their special interest in the field problems. I know there may be faults that can be found with the computer, but I am not looking for them. I hope that word can get spread around about the help they can give, because they have worked hard to try to prove the worth of the machine. I think possibly the reason more people do not take advantage of it is because they do not really know what it is capable of doing. Many pamphlets are available about the programs they have already worked out, and if you have a problem that they do not already have a program for, they will do their very best to work it out for you. I truly hope that the Highway Department will never be without this type of machine. How it works or why has never really interested me, but what it will do has, and I hope it will also interest you who have not been taking advantage of the computer.

Testing Asphalt Samples

Rodney Pirtle, Senior Journalist
Information and Statistics Division

In reading or writing an article on any by-product of another compound it is always interesting to note when the product was first used, and it is doubly interesting if it can be found that the product was once discarded as useless. Then, of course, it can be observed that one day, lo and behold, some brilliant scientist, amid the strange bubblings and hissings of nameless solutions, discovered that when a lump of the stuff was thrown into the waste can, it bounced back out. Or it stuck tightly to the bottom of the can. Or it stuck tightly to his hand and never reached the can. Anyway, a vital use was found for the substance, so goes the ideal story, and a tragic waste of a valuable material was averted.

In the lab, samples are heated, poured up into test containers, and cooled. Then, they are tagged with the number of their grade, lab number, and source. Howard Stark, Senior Lab Assistant, is removing two flash cups containing samples which will be put through the flash point test. This test is conducted as a safety precaution in handling asphalt and as an indicator of the presence of more volatile oils.

Scholars researching the subject of asphalt are likely to meet only with frustration and despair if they persist in pursuing this slant. Quite likely, even the more diligent ones will give up by the time they have traced this substance back to the Sumerians in the year 3800 B. C.

Fortunately, however, somewhat more recent discoveries have disclosed that certain qualities and grades of asphalt have been found to hold up better when applied to the building of highways. This, at last, is the long-sought tie-in to the Asphalt Testing Laboratory of Materials and Tests Division of the Highway Department.

If the solvent oils are removed from crude petroleum by evaporation or distillation, asphalt remains. The ancient Sumerians were lucky. They had sources of natural asphalt caused by natural separation of the asphalt from the lighter components of petroleum. Although some native asphalts are still used, all of the asphalt used by the Highway Department is the result of the refining of petroleum.

The bulk of the work carried on in the Asphalt Lab involves the testing of samples of asphalt that come in from refineries all over Texas and southern Oklahoma to determine

This bank of ovens is used mainly for testing asphaltic materials for evaporation loss on heating. The three smaller ovens nearest the camera are natural convection ovens containing shelves which rotate at five to six rpm to avoid unequal heating of samples caused by hot spots in the ovens. Two of the three smaller ovens are kept at 325 degrees for the testing of oil asphalts and the other at 212 degrees for testing lighter, more volatile materials. The latter is also used for drying samples. In the loss on heating test, samples are weighed, placed in the ovens and heated for five hours, cooled to room temperature, and reweighed. Richard McCulloch, Senior Lab Assistant, is shown placing an extracted thimble into the larger oven for drying, to be later removed and weighed on an analytical balance for the determination of asphaltic content of a treated fabric. A forced convection unit, this oven is also used for running flows on joint materials, both rubber and asphaltic, and for measuring the distortion of asphaltic joint material and backerboard.

whether the manufactured product meets the Department's specifications. Samples from sixteen sources are currently being tested, and this number is likely to jump to nineteen or twenty within the next few months.

Samples are received each day by the lab, and the day's work begins when the samples are picked up early in the morning at the bus or train terminal.

The asphalt is sampled at the refineries by Highway Department inspectors. In most cases, inspectors are kept at the plants at all times. After the producer indicates that a batch is ready to be sold, the inspector takes a sample, seals the tank he has just tapped, and sends the specimen to Austin for testing.

If the material passes the tests in the Asphalt Lab, the inspector at the refinery witnesses the loading of the asphalt and issues a loading certificate that accompanies the asphalt to the job where it is to be used. A copy of this certificate is also sent to the Austin laboratory.

Three types of asphaltic material are most often tested by the personnel at the laboratory—penetration grade, which is a semisolid; cutback grade, a liquid; and emulsified asphalt, also a liquid. The last two are manufac-

The penetration test is designed to determine the hardness or consistency of an asphalt by measuring the distance a blunt-pointed needle will penetrate a sample of the material. The needle is loaded with 100 grams of weight and applied to the surface of the asphalt for a period of five seconds. The unit of distance used in this normal penetration test is 1/10 millimeter, or about 1/254 of an inch. Not a quality test, penetration merely classifies the asphalts into grades according to their degree of hardness. Stated a little differently, penetration is an identification test used for selecting the proper grade of material for given conditions. The hands in this picture belong to L. L. Wallace, Section Supervisor.

The first step in testing cutback asphalts is the distillation test, which determines volatility and amount of solvent contained in the sample being tested. Here, Howard Stark takes readings on a group of cutback distillations. This test, which heats the material to 680 degrees, takes the sample down to base asphalt. Then, base asphalt tests such as penetration, ductility, and Oliensis may be run on this residue. The distillation unit shown here was built by the men in the Asphalt Lab.

tured by adding a liquefying agent in varying amounts to the penetration grades.

The relationship between the Asphalt Testing Laboratory and asphalt producers may be compared to that of automobile manufacturers and gasoline producers. There is a constant cooperative effort in both relationships to improve the service rendered by the finished product—the automobiles in one case and highways in the other.

The state government is the largest consumer of asphalt, and its consumption of this product is growing each year with our accelerated highway program. The first tests run in the Asphalt Lab of the new Materials and Tests Building at Camp Hubbard were in April of 1958. In that month the Highway Department contracted for the use of approximately 10 million gallons of asphalt. In the April 1959 letting, contract specifications called for about 17 million gallons.

In the fiscal year 1958, contracts were let calling for 76,750,000 gallons of asphalt. With four months still left on this year's fiscal calendar, the Department has contracted for 88 million gallons. This figure is expected to jump to the neighborhood of 140 million by the end of August. Add to this the 30 million gallons called for on maintenance requisitions, and one gets a fairly accurate picture of the magnitude of this business of asphalt testing.

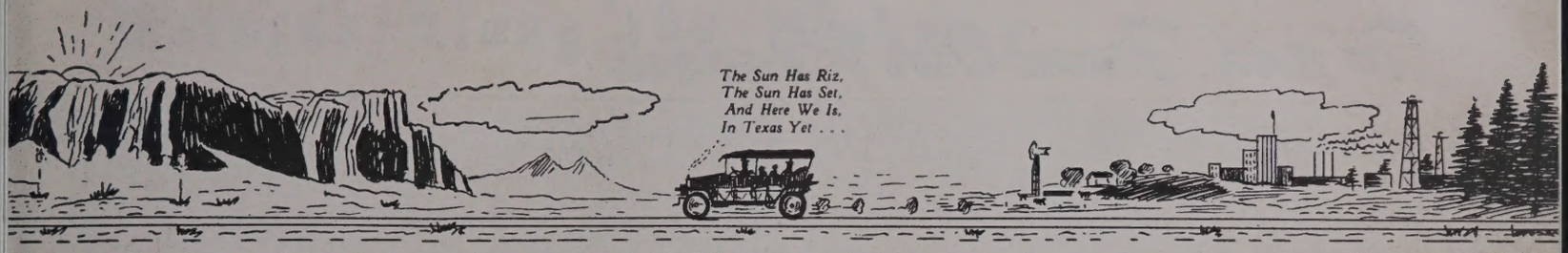
A viscosity test is run on all cutback and emulsion asphalts. This test is a measure of the liquid's resistance to flow. The instrument which Bill Wallin, Section Supervisor, is operating here is a viscosimeter. This unit measures the time required in seconds for 60 cubic centimeters of the sample at a designated temperature to flow from a tube through an orifice of standard dimensions into a measuring flask. The more viscous a sample is, the longer it will take the liquid to flow through the orifice and the closer it is to a semisolid. The use of this test makes possible the determination of the workability of various grades of cutbacks and emulsions.

Wallin puts some samples through the Oliensis test, which measures the homogeneous condition of the various constituents of the asphalt sample. In this test a well-defined solvent obtained from crudes is added to the samples in a specified ratio, warmed, and allowed to stand for 24 hours, after which the resulting solution is spotted onto white filter paper. If the stain remains a uniform color, the material is considered acceptable, or negative. If a darker center area shows up, it is an indication that the asphalt may have been damaged in the cracking process at the refinery.

All the men of the Asphalt Lab possess at least two qualities which make possible the handling of such a large job by a relatively small staff—versatility and experience. Each man can run every asphalt test in the lab. A knowledge of mechanics, electricity, and wiring has enabled them to build several of their own testing units, thereby saving the Department thousands of dollars. As for experience, they average sixteen years service with the Department.

Wallin and Weldon Chaffin, Supervising Chemical Engineer, watch a ductility test in progress. This test, made at 77 degrees in salt water, tap water, and a water-alcohol solution, is used to determine how much a specimen of asphalt will stretch before breaking. Thus, it gives an indication of the brittleness of a sample at a given temperature. There are four baths such as the one shown in this picture, all of which were designed by Chaffin and Wallin with the advice and assistance of Harry Sandberg, Principal Laboratory Engineer. The four baths, costing approximately $4,000 per unit on the commercial market, were built in the lab for a total cost of about $8,000. Wallin did most of the actual assembly and adjustment work on the units.

Pictures show a few of the routine tests which the samples must pass before state money is spent for asphalt.



OVER THE HIGHWAYS

Comments . . . from the Traveling Public

I would like a horned toad for my collection of reptiles. I had one once but unfortunately a little boy stepped on it. If you could possibly catch one or know of anyone who has one that could send me one, please notify me by send (*sic*) it to:

R. 1 Box 223
Kissimmee, Florida
Larry Smith

◈ *Do any of you West Texans have a spare under a rock?*

. . . (It) seems like Texans need to be educated to "Travel Texas." They seek out far-reached scenic spots when their own big state is full of great wonderland all around and about. Mountains, seashores, big trees aplenty. Why not conduct a campaign for a real good Texas slogan along these lines. See big Texas first!

The Texas Highway Department surely does deserve a big hand for their 1959 Highway Map. It is a beauty! The finest one yet!

We have just returned from a two weeks vacation in your fine State of Texas. We so thoroughly enjoyed using the Roadside Parks that we simply wanted to express to you and every one of your employees our grateful appreciation for their cleanliness, convenience, locations, and whole layout in general. . . .

Dr. H. Perry Bynum
Memphis, Tennessee

Last Saturday your department applied a seal coat and pea gravel on several miles of the highway west of ——. This type of gravel is very destructive to windshields and headlights when traffic is not controlled.

It occurs to me that the general public is entitled to more protection than is afforded by warning signs to drive slowly. Ninety per cent of the drivers will comply but the other 10 per cent hot rodders do a tremendous amount of damage.

Would it not be possible to station a patrol car on these newly topped highways for a few hours to slow down the speeders who disregard the warning signs to drive slowly?

Those who observe the warnings and drive slowly are the victims of the speeders who whiz by and throw gravel through windshields of the slower-moving cars. A large number of windshields and headlights were broken on this strip of road according to local garages.

Signed

By the American Embassy in Stockholm, I have got your address and they also ask me to write to you, as perhaps could give me such informations I want. What I would know is about Texas and specially cowboys, as all Swedish boys think is very hard and buff.

Please could you send me some pictures on cowboys or some magazine about it. I am specially interested in their clothes and their work how they work.

And now this questions should I like to know answer on. Please if possibly tell me it.

1. What kind of clothes wear a cowboy. Wear they for instance jeans?
2. Is all cowboys dirty on their clothes, and why so is the horses dirty?
3. How young boys is cowboys?
4. What are they doing on their free time?
5. Have cowboys nowdays a gun or colt as in all American cowboy movies?

If you would make the trouble to answer I would be very glad and also if you could look in the phone catalogue and tell me the address of a really cowboy (young if you know some) .

I know this is much to write for you but I hope to hear from you.

Ake Backlund
Dunkehallavagen 29
c/o Asen
Jonkoping, Sweden

◈ *This young man went to a lot of trouble to find out the facts. If you know a young cowboy, or if you have information for him, send him the word.*

To and From Our Readers

Connected with our highway technical library, we have an abstracting service which circulates magazines to interested personnel. At present we have three copies of TEXAS HIGHWAYS which we distribute. The demand for your magazine has increased so considerably during the past year that we find these three copies very inadequate. If you could send us an additional five we would appreciate it very much.

Librarian
Department of Highways
St. Paul, Minnesota

◈ *In Minnesota they appreciate us, ya.*

I would like to express my appreciation for such wonderful highways and roadside parks in your state.

My family and I recently completed a vacation to Georgia and return and in no state did facilities compare with those you offer. I was extremely impressed by the upkeep of your highway right of way, the ideally located roadside parks, their appearance and cleanliness were outstanding, and of course the beautiful highways we had the pleasure of driving on.

Donald Y. Morgan
M Sgt, US Army
Sacramento, California

"NICK, WE'RE GOING TO HAVE TO DOUBLE THE GUARD POST BECAUSE OF THESE FOREIGN CARS!"

About Our Pictures . . .

This month's cover shot pictures a crossover structure on Interstate 35 East, just south of State Highway 121 in Denton County. Sunday drivers along this engineering marvel might occasionally pine for the tree-lined dirt road of yesterday—until a heavy rain. Then they *might* remember the nightmare quality of those quaint scenic roads which instantaneously turned into miry monsters out to trap any unfortunate car which chanced along. Our all-weather expressways of today provide safe—and comfortable—travel all year around.

Inside front, the shade of a tree along U. S. 190 near Maysfield provides the lunch-hour setting for this hard-working maintenance crew. And after several hours work on a sizzling summer pavement, even a small tree is like a breath of the Arctic.

TEXAS HIGHWAY COMMISSION

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Texas Highways

TEXAS HIGHWAYS, official journal of the Texas Highway Department, is published in the interest of highway development in Texas and for departmental education in the improvement of construction, maintenance, and operation.

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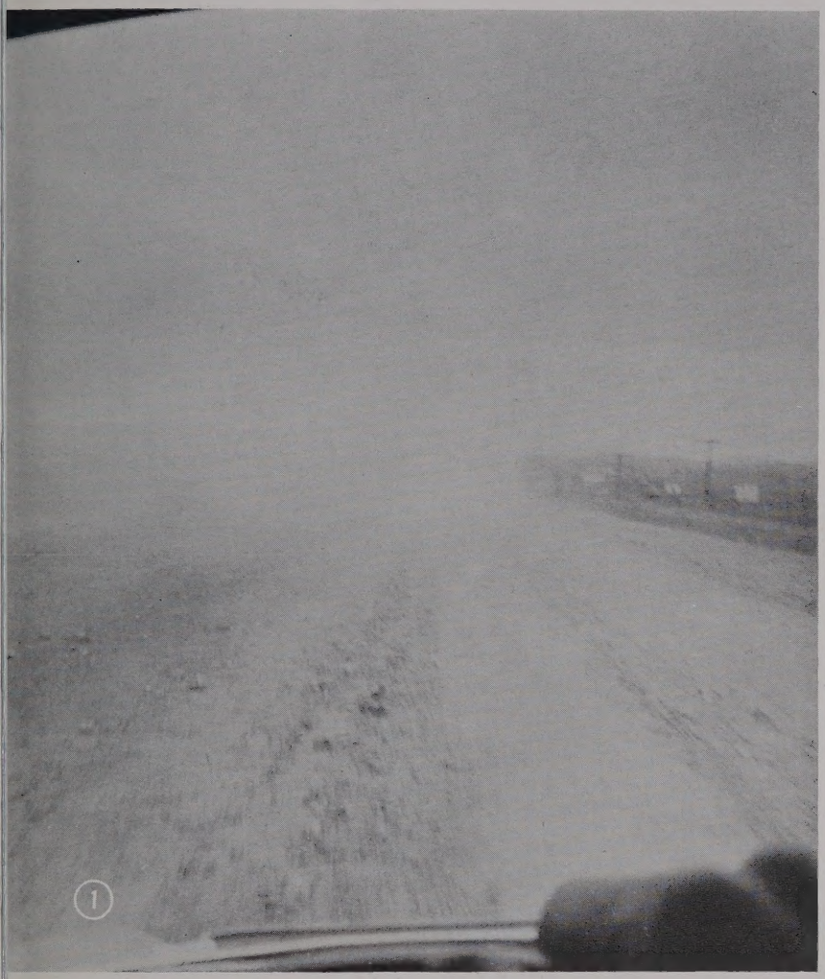
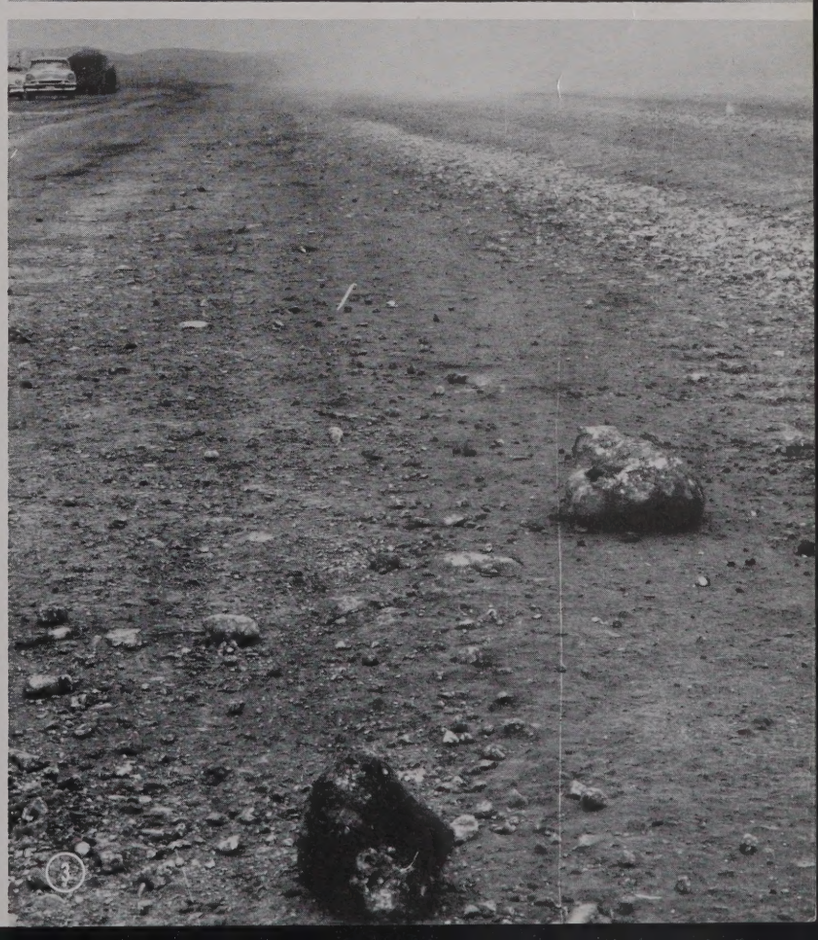
Hazards Along the Highway



The obstacle course pictured here is what one motorist encountered when he unsuspectingly entered a seventeen-mile stretch of highway which was undergoing widening.

First, a fast-moving piece of heavy construction equipment passed him, leaving in its wake this churning dust through which he was unable to see.

In the second picture is the grader which sped toward him through the blur, hurling rocks (which see in picture three) as it thundered past.

Though safety protection of the motorist is the responsibility of the construction firm which has been awarded the highway work contract, any accident resulting from lax precautionary methods will impair public good will toward the Highway Department.